AN ANALYSIS OF FIRE STATION ALERTING SYSTEMS

STRATEGIC ANALYSIS OF COMMUNITY RISK REDUCTION

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ABSTRACT

A major problem facing the Houston Fire Department is a Federal Communications Commission (FCC) mandate requiring the department to replace its existing Microwave Emergency Alerting System (EAS). This mandate forced the Houston Fire Department (HFD) to examine alternate solutions for its alerting system.

The purpose of this applied research project was to identify the advantages and disadvantages of Emergency Alerting Systems operating successfully in comparable jurisdictions and to utilize the findings to recommend an appropriate replacement Emergency Alerting System for the Houston Fire Department. The descriptive methodology was used in the research project to answer the following questions:

1. What were the types of Emergency Alerting System technologies used to alert and dispatch Fire and Emergency Medical Services in comparable jurisdictions?
2. How has the Federal Communications Commission's mandate to reallocate MAS Spectrum affected comparable jurisdictions?
3. What were the advantages and disadvantages of Emergency Alerting Systems successfully operating in comparable jurisdictions?
4. What Emergency Alerting System technology is most appropriate for the Houston Fire Department?

The procedure used to answer the four research questions included a 30-question survey mailed to 60 City and/or County Fire Departments. The criteria used to select survey participants were geographical area and population. The survey was, categorized into four closed-end (yes/no) questions, 23 opened-end (essay) questions, and three forced choice (multiple choice) questions.

The results of this research indicated that fire departments in comparable jurisdictions shared many common features. All surveyed departments received the majority of their request for service through 9-1-1. There were a wide variety of systems used to alert fire stations. However, they generally consisted of systems that turned on lights, generated alert tones over the Public Address (PA) system, and opened the PA to allow reception of voice messages. The research identified Mobile Data Dispatching, utilizing printed alerting information and mobile data terminals in vehicles, as the most appropriate alerting system technology for the Houston Fire Department.

The project has provided evidence to support a recommendation that the Houston Fire Department develop a replacement Emergency Alerting System based on mobile data technology.

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INTRODUCTION

The topic chosen for my applied research project was "An Analysis of Fire Station Alerting Systems."

A major problem facing the Houston Fire Department (HFD) is a Federal Communications Commission (FCC) mandate requiring the department to replace its existing Microwave Alerting System (MAS). The MAS is the primary method used by the Houston Fire Department dispatchers to alert stations and dispatch emergency medical services and fire suppression personnel to emergency incidents from the Central Dispatch Center. This FCC mandate prompted the Houston Fire Department to seek technical information from comparable jurisdictions that would allow the department to develop plans for a replacement EAS.

The purpose of this applied research project was to identify the advantages and disadvantages of Emergency Alerting Systems operating successfully in comparable jurisdictions and to utilize the findings to recommend an appropriate replacement Emergency Alerting System for the Houston Fire Department.

Descriptive research methods were used to answer the following research questions:

1. What were the types of Emergency Alerting System technologies used to alert and dispatch Fire and Emergency Medical Services in comparable jurisdictions?
2. How has the Federal Communications Commission's mandate to reallocate MAS Spectrum affected comparable jurisdictions?
3. What were the advantages and disadvantages of Emergency Alerting Systems successfully operating in comparable jurisdictions?
4. What Emergency Alerting System technology is most appropriate for the Houston Fire Department?

BACKGROUND AND SIGNIFICANCE

Houston Fire Department

The City of Houston is the fourth largest city in the United States, with a population of over 1.8 million. The city government provides the citizens of Houston with fire and police protection, civic events, airports, libraries, park facilities, street maintenance, water, garbage collection, and other municipal services. Services are provided through 19 departments consisting of over 20,000 employees.

HFD is responsible for fire suppression, emergency medical response, hazardous material mitigation, fire safety inspection, arson investigations, hydrant inspections, and street indexing within the city limits of Houston. Over 3,150 emergency responders operate from 85 fire stations, strategically positioned to cover an area of approximately 800 square miles. The Houston Fire Department utilizes 270 emergency vehicles to respond to an estimated 75,000 fire and 180,000 emergency medical incidents on an annual basis.

The City of Houston uses a mayoral form of government where the Fire Chief and all other department heads report directly to the Mayor. The fire department is one of 19 departments within the City of Houston and is divided into eight divisions. An Assistant Fire Chief who reports directly to the Fire Chief heads each division.

Central Command Division

One of the eight HFD divisions is Central Command. The Central Command Division provides a myriad of highly specialized and technical services for the department and the citizens of the City of Houston. However, the division's primary duty is to receive calls for fire and EMS assistance, immediately dispatch the appropriate personnel and equipment to the scene, and record pertinent incident information. The 9-1-1 Center transfers citizen calls directly to the fire

department's Central Dispatch Center. At a call taker position a dispatcher will determine whether an incident is a medical or fire incident. The call taker will fill in the appropriate information on a Computer Aided Dispatch (CAD) terminal and send the CAD incident screen to the appropriate radio position to be dispatched. Incidents are queued to one of six dispatch positions and the CAD System distributes these queued incidents and continues to monitor the availability of recommended units. After the CAD system has selected the units for dispatch and has created an incident number, the dispatcher has a choice of one of three alerting systems: the Microwave Alerting System, an UHF Alerting System, or the public telephone system.

The primary Emergency Alerting System used to dispatch personnel to the scene of emergencies consists of six Motorola CentraCom Series II Plus Dispatch Consoles interfaced to a Motorola INTRAC Microwave Alerting System and a Bull status computer. Each fire station is equipped with an alerting system radio receiver connected to an INTRAC Microwave Alerting System. The alerting receiver and the INTRAC Microwave Alerting System receives all alerting transmissions and energizes relays that activate other alerting equipment when the system recognizes a unique address code for a particular fire station. These relays start a 60-second timer, activate lights, and connect one of six dispatch microwave audio channels to the fire station speakers. In addition, a relay is energized in order to give confirmation to the dispatcher that the station is being alerted.

The Houston Fire Department utilizes two secondary methods of alerting fire stations if the primary method is unavailable. The first alternative method used is an UHF Simulcast Radio System that was installed in 1992. This secondary alerting system channel is also used for voice communications between dispatch and field units for fire incidents. The voice traffic is passed to additional tactical channels during multiple alarm, high-rise, and hazardous material incidents.

Additionally, this system transmits address information to select a single fire station or all fire stations. This system allows only one incident to be alerted at any one time and does not provide an "under alert" status reports to dispatchers.

The second alternative method used to alert a fire station is the public telephone network. Utilizing this method, each station would be called to respond to an emergency incident via the telephone.

The Federal Communications Commission granted the Houston Fire Department a developmental license in the early 1970's for 200 kilohertz of bandwidth in the 952.2-Megahertz frequency range. However, the Federal Communications Commission has mandated reallocation of that Microwave spectrum. Part 94.65 of the Federal Communications Commission Rules and Regulations required that all licenses granted before August 1, 1975, rechannel their systems to use 12.5 kHz of bandwidth by June 11, 1996. The reduced bandwidth will not support the multiplexed functions now performed by the microwave system; therefore, the department must develop an alternative station alerting system. The Houston Fire Department has been operating its primary Microwave Alerting System on a Special Temporary Authority from the Federal Communications Commission since June 11, 1996. The Special Temporary Authority must be renewed every six months. Renewal of the Special Temporary Authorities to continue operation of the microwave is based on the department's ability to show significant progress towards developing a replacement plan. In the event a renewal is not granted before a replacement system is developed, the citizens of the City of Houston will be placed at a significant risk of Fire, EMS, and Hazardous Material incidents.

This project addressed the applied research requirements associated with the Strategic Analysis of Community Risk Reduction Course at the National Fire Academy. This paper

relates to Haddons's Ten Countermeasures described in the Introduction to Community Risk Reduction Unit of the Strategic Analysis of Community Risk Reduction Student Manual. The project specifically relates to Haddon's ninth countermeasure, which identifies an adequate 9-1-1 system as an essential countermeasure to damage done by a hazard in the community. The Houston Fire Department Emergency Fire stations alerting system is an integral part of the community's 9-1-1 system.

The results of this study are of paramount importance to the safety of the citizens of Houston and the operational efficiency of the department. The intent of this research is to provide information that will allow the Houston Fire Department to develop a state-of-the-art Emergency Alerting System that will guarantee the fire departments response to each and every incident in a timely and efficient manner.

LITERATURE REVIEW

The literature review identified printed material relative to the Federal Communications Commission's (FCC) decision to reallocate spectrum previously allocated for public safety use. In 1991, McMillian reported that the FCC provides the regulatory function by means of allocation, licensing, and rule-making for all except Federal Government allocations. Part 94.65 of the Code of Federal Regulations (1991) stated, "Licensees of systems licensed before August 1, 1975, that conduct OFS operations on frequencies now assigned to MAS to move their operations to meet the current regulations by June 11, 1996" (p. 2).

The Report of the President's Commission on Critical Infrastructure Protection (1997a) addressed the issue of the Federal Communications Commission decision to auction segments of the electromagnetic spectrum with the following statement:

> The FCC has been auctioning segments of the electromagnetic spectrum. As demand rises for commercial bandwidth, spectrum becomes increasingly scarce, placing non-revenue generating public sector users, such as federal, state, and local emergency services, under increasing pressure to relinquish relatively under-used portions of their bandwidth allocations (p. 44).

Further addressing the subject of auctioning segments of radio spectrum, the Report of the President's Commission on Critical Infrastructure Protection noted that "The National Telecommunications Information Administration and the FCC—sponsored Public Service Wireless Advisory Committee (PSWAC) issued a joint recommendation, which the Commission endorses, that the FCC designate inviolate spectrum segments for emergency services—removing them from future auction consideration" (1997b, p. 44).

In 1994, Grenados advised in a Firehouse magazine article that "in major metropolitan areas of the United States, there simply aren't any more frequencies available. The FCC has already licensed 74,000 radio systems in the five services labeled public safety."

The Report of the President's Commission on Critical Infrastructure Protection (1997c) has made the following recommendation to the Federal Communications Commission to ensure compensation of state and local emergency service providers for the cost of replacement equipment, training, and transmission capabilities:

- Allocate an additional 25 MHz of unencumbered spectrum for public safety.
- Provide 2.5 MHz in the VHF and UHF bands for interoperability among emergency service providers.
- Plan for allocation of an additional 70 MHz for new technology applications in law enforcement and emergency services.

- Immediately factor other detailed recommendations of the PSWAC into the spectrum allocation planning process (1997c, p. 44).

The Code of Federal Regulations and the Report of the President's Commission on Critical Infrastructure Protection influenced this project by providing the reason and background for the research. The writings of Grenados and McMillian influenced this research by providing additional background.

The literature review identified several National Fire Protection Association (NFPA) standards that addressed Emergency Alerting Systems in the fire service. NFPA Standard Number 1201, 1994 Edition, entitled, "Standard for Developing Fire Protection Services for the Public," stated in Chapter 16-4.2 that "A minimum of two approved methods shall be available to transmit a dispatch message from communications to each fire station so that a fully independent back-up is available in the event of failure of the primary method" (NFPA 1201, 1994, p. 17). In Chapter 16-4.5, the standard goes on to state that "Appropriate methods shall be employed to alert personnel within each fire station when an alarm is received. These methods shall include the activation of lights, audible devices, activated automatically or by a member assigned to house-watch duties" (NFPA 1201, 1994, p. 17). Chapter 16-4.9 of the same standard indicates that " A high priority shall be placed on maintaining all dispatch equipment and system in full working order at all times" NFPA 1201, 1994, p. 17). NFPA Standard Number 1221, 1994 Edition stated, " The dispatch of the appropriate fire services shall be made within 60 seconds after completing receipt of an emergency alarm (NFPA 1221, 1994, p. 8). NFPA Standard Number 1221, 1994 Edition, also stated that, "Two separate dispatch circuits shall be provided for transmitting alarms. A circuit terminating at a telephone instrument only shall not be considered as either of the required dispatch circuits" (NFPA 1221, 1994, p. 12).

NFPA Standard Number 1201, 1994 Edition, states, "fire departments must provide reliable communications systems that complies with NFPA 1221" (NFPA 1201, 1994, p. 16).

The NFPA standards influenced this research by providing the standards and operational requirements of an effective fire service Emergency Alerting System.

The Fire Department Communications Manual addresses Mobile Data Systems with the following statement:

> The increasing demand for more and better communications while still meeting the basic objective of rapid dispatch has caused many departments to turn to digital data communications. A verbal dispatch to multiple units using conventional radio methods may take as much as one minute for broadcast and acknowledgement. That same dispatch can be done digitally in less than five seconds. One digital radio channel can handle, roughly, ten times as many messages as a conventional voice frequency (1995, p. 9).

The Fire Department Communications Manual also stated that, "When a Mobile Data System is tied to a modern computer-aided dispatch system, the time of dispatch, from receipt of the call to automatic acknowledgment from the responding units, can be less than one minute" (1995, p. 9).

The Fire Department Communications Manual further addressed mobile data systems with the following statement:

> The written message of the MDT also alleviates the problem of the spoken message being misunderstood (such as transposing address numbers). For those departments with heavy voice traffic, the MDT system is an excellent tool for reducing traffic to just the tactical needs of commanding incidents (1995, p. 9).

The Fire Department Communications Manual noted in (1995) that new digital data technology would quickly bring new communication features to the fire service. The power and capability of computers will become a standard part of a fire department communications system. Tied to a digital radio, computers can quickly provide important text or images to responding units. Through the use of digital radio technology, any record in the data banks would be available to emergency responders.

The writings taken from the Fire Department Communications Manual influenced this research project by providing information on cutting edge technology that highlights the increased sophistication of communication equipment currently available.

PROCEDURES

The research for this project began with a review of the City of Houston and Harris County Library Systems for all public and private sector printed material relative to the advantages and disadvantages of Emergency Alerting Systems operating successfully in comparable jurisdictions to Houston. The review provided no information that could be utilized to develop a replacement Emergency Alerting System for the department. Through the inter-library loan process, a review of available literature at the Learning Resource Center (LRC) of the National Emergency Training Center in Emmitsburg, Maryland, only provided two articles appropriate for the research. However, additional literature reviews conducted at the Houston Fire Department Library and the author's personal library identified several publications that were very useful to the research project. Although these published findings and observations were summarized in the Literature Review, they were too limited in scope and quantity to support the total premise of the research project. The limitation placed on the project by the lack

of comprehensive information on Emergency Alerting Systems successfully operating in jurisdictions comparable to Houston indicated that a supplemental method of gathering the required information would be necessary. The method chosen was to conduct a survey of City and/or County Fire Departments whose jurisdictions and fire dispatching requirements were comparable to those of the City of Houston. The purpose of the survey was to gather viable information on Emergency Alerting System methods among a variety of other major cities throughout the United States. The goals and objectives of the survey were to:

- Determine the types of Emergency Alerting System technologies used to alert and dispatch Fire and Emergency Medical Services in comparable jurisdictions.
- Determine what were the advantages and disadvantages of Emergency Alerting Systems successfully operating in comparable jurisdictions.
- Determine how the FCC's mandate to reallocate MAS spectrum affected comparable jurisdictions.
- Determine what Emergency Alerting System technology is most appropriate for the Houston Fire Department.

The survey was mailed to 60 City and/or County Fire Departments. The criteria used to select survey participants were geographical area and population. The survey research was limited by the fact that, while smaller fire departments were using more modern technology, there were no major fire departments using modern dispatch technology that could be compared directly with the City of Houston. The department has 85 fire stations spread across an 800 square mile radius. The surveyed departments consisted of 50 departments serving populations of 200,000 or more and 10 departments serving populations of less than 200,000. Each survey was augmented with a cover letter describing the purpose of the study, instructions, and a

comment indicating the survey results would allow the Houston Fire Department to develop an Emergency Alerting System Replacement Plan. A copy of the cover letter is provided in Appendix A. Potential responders were advised that all answers were confidential and would be used only in conjunction with those of other Fire Chiefs and upper-level fire service managers. A self-addressed envelope was included with the survey to expedite the completion and return rate. Also, for the same reason, the survey was kept very simple and limited. The cover letter advised each survey recipient that a complimentary copy of the survey findings would be mailed to any respondent who provided a name and address at the end of the survey.

The survey was mailed on January 27, 1998, and was due by April 13, 1998. By the deadline, 35 surveys or 58% were returned. Land (1992) stated, " A large number of factors can affect response rates in mailed questionnaire surveys. A natural question to ask is, what constitutes an adequate response rate" (p. 8). According to Babble, (1973), " A response rate of at least 50 percent is adequate for analysis and reporting. A response rate of at least 60 percent is good. And a response rate of 70 percent or more is very good" (p. 40). Therefore, the 58% return rate from the targeted departments was considered more than adequate for the purpose of this research.

The survey consisted of 30 questions, categorized into four closed-end (yes/no) questions, 23 opened-end (essay) questions, and three forced choice (multiple choice) questions. Included in the Results section are tables that describe the significant factors of the survey. A copy of the survey is found in Appendix B.

In addition to the original research questions, numerous other questions were identified in the survey as important to the research project. The original research questions are listed below.

- What were the types of Emergency Alerting System technologies used to alert and dispatch Fire and Emergency Medical Services in comparable jurisdictions?
- How has the Federal Communications Commission's mandate to reallocate MAS Spectrum affected comparable jurisdictions?
- What were the advantages and disadvantages of Emergency Alerting Systems successfully operating in comparable jurisdictions?
- What Emergency Alerting System technology is most appropriate for the Houston Fire Department?

Definition of Terms:

- CAD -- Computer Aided Dispatch.
- VHF -- Very High Frequency (33 MHz - 46 MHz) (150 MHz-174 MHz).
- UHF -- Ultra High Frequency (450 MHz - 460 MHz).
- Microwave Alerting System -- High frequency (two-Gigahertz FM radio systems).
- Hard-wired -- Municipal alarm lines or leased telephones lines.
- Trunked -- A radio system adapted from the telephone industry that utilizes a computer to manage the systems functions more efficiently.

RESULTS

Response to the Communication Systems Survey was good. More than 50 percent of the surveys were completed and returned. In addition, many jurisdictions provided technical system specifications that further explained the operations of their Emergency Alerting Systems. While it was not practical to include all of the information in this paper, interested departments may contact the author to make inquiries about specific systems.

The data from all surveys returned have been collated and are presented in the following tables.

COMMUNICATION SYSTEMS SURVEY RESULTS

Table 1

I CITY/STATE	**II** POPULATION	**III** # OF STATIONS	**IV** SQUARE MILES	**V** # OF VEHICLES	**VI** # OF PERSONNEL
Indianapolis IN	900,000	56	400	350	750
Phoenix AZ	2,000,000	49	1000	250	1500
Toledo OH	330,000	17	84	46	525
Midland TX	120,000	9	902	36	163
Louisville KY	249,000	22	62.5	200	658
Orland IL	75,000	6	38	39	153
Pensacola FL	70,000	7	14	14	130
Arlington TX	280,000	16	100	32	260
Charlotte NC	513,000	32	232	63	852
Richmond VA	201,000	20	62.5	84	425
Cincinnati OH	350,000	26	76	55	785
Nashville TN	550,000	36	533	76	1200
Memphis TN	625,000	49	281	150	1500
Lexington KY	240,000	19	288	100	477
St. Cloud MN	58,000	5		15	57
New Orleans LA	500,000	33	460	56	800
Kansas City MS	441,250	34	314	61	835
Dallas TX	1,030,000	55	378	104	1815
Arlington VA	220,000	10	25	25	248
Philadelphia PA	1,500,000	60	136	225	2505
Washington DC	555,000	32	69	88	1732
Milwaukee WI	617,000	36	96	69	1062
Columbus GA	198,562	13	221	25	293
Birmingham AL	265,000	30	167	72	684
San Francisco CA	750,000	41	49	102	1800
Broward Co. FL	165,000	20	110	36	450
Seattle WA	600,000	34	92	80	990
Volusia Co. FL	120,000	21	950	110	350
Akron OH	223,000	13	38	62	411
Cedar Rapids IA	110,000	9	60	16	160
Auburn AL	40,000	4	35	8	80
Los Angeles CA	3,200,000	137	2250	185	2500
Oakland CA	380,000	25	58	371	563
Buffalo, NY	330,000	25		50	540
San Angelo, TX	92,400	7	1500	29	14
Averaged Totals	511,377	29	317	94	779

COMMUNICATION SYSTEMS SURVEY RESULTS

Table 2

I CITY/STATE	**II** ANNUAL # of FIRE INCIDENTS	**III** ANNUAL # of EMS INCIDENTS	**IV** # of VOICE RADIO CHANNELS	**V** # of CALL TAKER POSITIONS	**VI** # of DISPATCH CONSOLES
Indianapolis IN	20,000	80,000	27	9	9
Phoenix AZ	175,000	130,000	10	3	18
Toledo OH	8,300	39,500	9	10	4
Midland TX	4,691	6,039	22	1	1
Louisville KY	10,000	60,000	12	10	5
Orland IL	1,300	5,200	8	1	2
Pensacola FL	347	3,369	10	2	1
Arlington TX	9,056	36,180	14	10	4
Charlotte NC	3,000	35,000	28	4	4
Richmond VA	24,824	35,099	4	8	2
Cincinnati OH	16,000	46,000	5	13	3
Nashville TN	31,206	54,860	17	4	4
Memphis TN	55,000	72,000	14	3	2
Lexington KY	8,500	22,000	1	4	4
St. Cloud MN	348	364	4	1	1
New Orleans LA	24,000		25	7	4
Kansas City MS	6,249	26,969	9	18	2
Dallas TX	92,364	127,566	14	8	3
Arlington VA	6,876	14,738	14	16	4
Philadelphia PA	56,915	150,706	7		5
Washington DC	39,491	71,475		13	7
Milwaukee WI	10,000	60,000	24	3	6
Columbus GA	9,025	17,522	10	4	2
Birmingham AL	10,335	35,797	3	2	2
San Francisco CA	33,852	66,092	5	5	3
Broward Co. FL	100,000	80,000	25	2	6
Seattle WA	20,000	60,000	3	5	5
Volusia Co. FL	2,400	9,800	21	6	2
Akron OH	9,461	29,053	30	12	4
Cedar Rapids IA	2,550	3,000	30	12	4
Auburn AL	1,200		1	7	1
Los Angeles CA	71,000	124,000	15	9	20
Oakland CA	5,000	48,000	15	6	6
Buffalo, NY	9,000	42,000	2	6	2
San Angelo, TX	4,200	6,000	20	2	2
Averaged Totals	25,157	45,668	13	6	4

COMMUNICATION SYSTEMS SURVEY RESULTS

Table 3

I CITY/STATE	**II** MAST	**III** MDT's	**IV** TYPE DISPATCH SERVICE	**V** EMS TRANSPORT	**VI** SUPPRESSION FIRST RESPONDER	**VII** TYPE DISPATCH EQUIPMENT
Indianapolis IN	1	1	2,3,4,5,6	1	1	1,2,6
Phoenix AZ	2	1	2,3,4,5,6	1	1	1,3,6
Toledo OH	1	2	4,2,3	1	1	1,2,6
Midland TX	2	1	1,2,3,4,5,6,7	1	1	1,2,6
Louisville KY	2	2	2,3	1	1	1,2,3
Orland IL	2	2	1,2,3,6	1	1	1,2,3,6
Pensacola FL	2	2	1,2,6,7	1	1	1,2,3,6
Arlington TX	2	1	1,2,3,4,5,6,7	2	1	1,2,6
Charlotte NC	2	2	2,3,6	2	1	1,6
Richmond VA	1	1	1,2,3,5,6,7	2	1	1,2,3,6
Cincinnati OH	1	2	1,2,3,4,5,6,7	1	1	4,5,6
Nashville TN	2	2	2,3,4,5,6	1	1	1,2
Memphis TN	2	2	2,3,4,5,6	1	1	3,6
Lexington KY	2	2	2,3,4,5,6	1	1	2,3,6
St. Cloud MN	2	2	2,6	2	1	1
New Orleans LA	2	2	2,6	2	1	1,2,6
Kansas City MS	2	2	2,3,4,5,6	2	1	
Dallas TX	2	1	2,3,4,5,6	1	1	1,2,3,4,5,6
Arlington VA	1	2	1,2,3,4,5,6,7	1	1	1,2,3,4,5,6
Philadelphia PA	1	2	2,3,4,5,6	1	1	2,6
Washington DC	2	2	2,3,4,5,6	1	1	2,4,5,6
Milwaukee WI	1	2	2,3,5,6	1	1	1,2,6
Columbus GA	2	2	1,2,3,5,6,7	1	1	2,3,6
Birmingham AL	2	2	2,3,4,5,6	1	1	1,2,3,6
San Francisco CA	2	2	2,3,4,5,6	1	1	1,2,3,4,5,6
Broward Co. FL	2	1	1,2,3,4,5,6	1	1	2,6
Seattle WA	1	2	2,3,4,5,6	1	1	1,2,6
Volusia Co. FL	1	2	2,3,4,5,6	1	1	1,2,3,,6
Akron OH	2	2	1,2,3,4,5,6	1	1	1,2,3,6
Cedar Rapids IA	2	1	1,2,5,6,7	2	1	1,2,3,4,5,6
Auburn AL	2	2	1,2,5,6,7	2	1	6
Los Angeles CA	1	1	2,3,4,5,6	2	1	
Oakland CA	2	2	2,3,4,5,6	2	1	1,2,3,6
Buffalo NY	2	2	2,3			
San Angelo, TX	1	1	2,3,4,5,6	2	1	1,2,3,6

Note. Columns II, III, V, and VI: 1) Indicates – Yes, 2) Indicates – No. Column IV: 1) Police Dispatching, 2) Fire Dispatching, 3) EMS Dispatching, 4) Pre-Arrival Instructions, 5) EMS Call Taking, 6) Fire Call Taking, 7) Police Call Taking. Column VII: 1) ANI/ALI, 2) TDD, 3) ANI/ALI CRT, 4) ANI, 5) ALI, and 6) CAD Terminal.

One of the goals of this investigation was to determine the types of Emergency Alerting System technologies being used to alert and dispatch fire and Emergency Medical Services in jurisdictions comparable to Houston. An additional goal of this research was to determine if comparable entities were utilizing innovative proven technology that could be easily adapted for reuse by the Houston Fire Department. The survey research identified nine types of alerting system technologies used to alert and dispatch Fire and Emergency Medical Services in jurisdictions comparable to Houston. The criteria used for comparison were geographical area and population. The average population of surveyed jurisdictions was over 500,000. The chart below identifies the type(s) of alerting system technologies used to alert and dispatch Fire and Emergency Medical Services in comparable jurisdictions.

ALERTING SYSTEM TYPE/USAGE

Table 4

CITY/STATE	UHF	900 MHz	800 MHz	PAGING	VHF	ZETRON	MICRO-WAVE	MOBILE DATA	HARD WIRED
Indianapolis IN			X					X	
Phoenix AZ		X	X						
Toledo OH			X						
Midland TX						X		X	
Louisville KY	X								
Orland IL*		*Must purchase all new radios					X		
Pensacola FL						X			
Arlington TX			X					X	
Charlotte NC*			X	*Moved to 800 MHz			X		
Richmond VA*	*Moving to 800 MHz						X	X	
Cincinnati OH	X					X			
Nashville TN	X								
Memphis TN	X								
Lexington KY					X	X			
St. Cloud MN			X						
New Orleans LA			X			X			
Kansas City MS			X						
Dallas TX	X								
Arlington VA			X				X		
Philadelphia PA	X							X	
Washington DC			X		X				X
Milwaukee WI			X		X				
Columbus GA									
Birmingham AL	X								
San Francisco CA	X								
Broward Co. FL				X					
Seattle WA	X					X			
Volusia Co. FL*			X		X	*Rushed into 800 MHz			
Akron OH			X						X
Cedar Rapids IA			X	X		X			X
Auburn AL				X	X				
Los Angeles CA	X							X	
Oakland CA									
Buffalo NY					X				
San Angelo, TX			X						

Note. (*) Identifies departments that have been affected by the FCC's mandate to reallocate MAS spectrum.

According to the survey research, four of the 35 surveyed jurisdictions were affected by the FCC's mandate to reallocate MAS spectrum. These four jurisdictions were affected as follows:

- The City of Orland must purchase all new radios.
- The City of Charlotte moved to an 800 MHz system.
- The City of Richmond is currently moving to an 800MHz system.
- Volusa County was rushed into an 800 MHz system before they were ready.

The advantages and disadvantages of the nine successful Emergency Alerting Systems operating in jurisdictions comparable to Houston are described below.

Arlington, TX

The City of Arlington Texas has a population of 280,000. The city currently operates 16 fire stations and 32 emergency vehicles serving an area of 100 square miles. The department is staffed by 260 paid personnel.

Mobile Data Alerting System

The Arlington Fire Department receives requests for service through an enhanced 9-1-1 system. The fire dispatchers alert fire stations and apparatus through simultaneous voice broadcast to three talk groups. The first talk group is monitored by all fire apparatus mobile and portable radios. The second talk group is monitored by Emergency Medical Vehicles. The third talk group is for fire station alerting only and is monitored by a trunked radio at the fire station that is interfaced to the station public address system.

When an alert is initiated, the fire station radio triggers a relay that connects its audio to the public address system. The dispatcher presses an alert tone button on the console and then

announces the alert. Any personnel in the vicinity of the fire station who cannot hear the station public address system will also hear the voice alert over their portable radios. A CAD terminal provides a mobile data dispatch to all assigned apparatus and to mobile data terminals at each fire station interfaced to a printer that prints the alert information. The CAD terminal allows automatic dispatching initiated by a call taker. Responding units report status using Mobile Data Terminals that automatically update the CAD unit status screen. The CAD system is able to track the time the dispatch was sent and the fact that the unit is en-route. Upon completion of the assignment, the entire incident record, along with times, is down loaded into the Records Management System. The survey findings did not uncover any disadvantages to the Mobile Data Alerting System operating in this jurisdiction.

Midland, TX

The City of Midland, Texas has a population of 120,000. The city currently operates nine fire stations and 36 emergency vehicles serving an area of 902 square miles. The department is staffed by 163 paid personnel.

Zetron Alerting System

The City of Midland Fire Department receives request for emergency service through a 9-1-1 system. Fire stations are alerted through a Zetron 25 Station Transponder, which detects a signal from the station trunked radio when it hears the alert call on the fire dispatch talk group. The Zetron unit opens the fire station public address system and connects the trunked radio channel audio to it. Responding units report status by voice and mobile data. Incident alerts are transmitted to the fire station remote CAD terminal and its associated printer, while at the same time, the incident information is transmitted to the mobile data terminal in the fire apparatus. The completed incident record is down loaded to the Records Management System for future

use. The remote CAD terminal at the station can also be used to access the records management system for such things as report completion, inventories, and training. A major disadvantage to the Zetron Alerting System is responding units must report status by voice and mobile data. This method duplicates effort and causes unnecessary communication.

San Angelo, TX

The City of San Angelo, Texas has a population of 92,400. The city currently operates seven fire stations and 29 emergency vehicles serving an area of 1,500 square miles. The department is staffed by 140 paid personnel.

800 MHz Trunked Radio System

Fire stations, apparatus, and associated vehicles are alerted by the trunked radio system utilizing a reserve talk group. At fire stations, an E.F. Johnson Trunked Radio is interfaced to the station's PA system, station house lights, and an alarm bell. The interface is a momentary signal from the radio that activates equipment to connect the radio's audio to the PA for 40 seconds, sounds the alarm bell, and turns on the lights. When the dispatcher activates a call to the talk group, it triggers the fire station radio interface to activate alert functions. The dispatcher presses a manual alert tone button and then announces alert and dispatch information over the trunked radio channel for all stations, apparatus, and vehicles. A weakness to this system is the fact that incident status reporting is performed verbally through the trunked voice radio system, rather than through some type of status terminal.

Buffalo, NY

The City of Buffalo has a population of 330,000. The city currently operates 25 fire stations and 50 emergency vehicles. 540 paid personnel staff the fire department.

VHF High Band

The Department operates one VHF high band repeater channel for dispatch purposes and one VHF simplex channel for fire ground communications. Stations are simultaneously alerted by voice radio on the single dispatch panel and a voice alarm over a dedicated, Fire Department owned and maintained, cable plant connecting all stations. The voice alert from the dispatch position is transmitted to an amplifier at each of the 25 fire stations and is amplified simultaneously over a common set of loud speakers in the station house. The system allows every station house to continuously be aware of the status of fire dispatches.

Arlington, VA

The City of Arlington Virginia has a population of 220,000. The city currently operates 10 fire stations and 25 emergency vehicles serving an area of 25 square miles. The department is staffed by 248 paid personnel.

Microwave Alerting System

The Arlington Fire Department receives requests for service through its 9-1-1 lines, or from alarm monitoring services through seven digit lines. The tone and voice alerts are provided through a Microwave INTRAC system operating on the city's 15 channel SmartNet 800 MHz radio system. The alerted stations are provided with a paper printout of the call details from the CAD system. Responding units acknowledge the call by pressing a button on a status message head on their radios. The status message heads also have buttons to indicate, "in route", "on site", etc., all of which are reported and displayed on the CAD system. Backup alerting is accomplished through leased telephone lines.

City of Los Angeles, CA

The City of Los Angeles has a population of 3,200,000. The city operates 137 fire stations and 185 emergency vehicles serving an area of 2,250 square miles. The department is staffed by 2,500 paid personnel.

Hard Wired Alerting System

The City of Los Angeles Fire Department receives its calls from the primary Public Service Answering Point 's (PSAPs) at the City Police or the County Sheriff's Office. The City also has at least 750 high rises with supervised alarm systems, which are reported to Fire Dispatch through seven digit phone lines. Calls are received by the call takers, who code the calls into the City's System House CAD system. Calls are then transferred to dispatchers. The dispatchers then select one or more of the cities 137 Fire Stations from the list recommended by the CAD system. Selected stations are notified of emergency assignments over the station PA system. Paper printouts with call information are also provided at the stations. Doors and traffic lights are controlled at some stations. The stations are linked to the dispatch center by City owned and maintained wire circuits.

Phoenix, AZ

The City of Phoenix has a population of 2,000,000. The city operates 56 fire stations and 250 emergency vehicles serving an area of 400 square miles. The department is staffed by 1,500 paid personnel.

900 MHz DARCOM System

The City of Phoenix Fire Department operates a regional dispatch center for 13 Fire Departments. They are a secondary PSAP, receiving their calls from primary PSAP’s at the

police Department. The Phoenix Fire Department also receives calls on seven digit lines from alarm monitoring services. The CAD sends fire station alerts over the city's 900 MHz point to multi-point DARCOM system. The system turns on lights inside the station house, activates alert tones, opens speakers to receive radio voice announcements, and sends call details to a printer. Calls are acknowledged by hitting a button on an enunciator panel on the terminal screen. The station houses are also divided into zones, such as bunkrooms for individual engine crews, dayrooms, which can be alerted individually or in combination. A terminal is located in each of the separate zones.

Louisville, KY

The City of Louisville has a population of 249,000. The city operates 22 fire stations and 200 vehicles serving an area of 62.5 square miles. The department is staffed by 628 paid personnel.

UHF Alerting System

The City of Louisville Fire Department receives its calls from the primary Public Service Answering Point at the city police department. The department is in the process of developing a CAD system. Fire station alerting is done over a 460 MHz UHF radio system. At the alerted station, the lights are turned on, tones are heard over the PA, and voice instruction follow.

Broward County, FL

Broward County has a population of 165,000. The county currently operates 20 fire stations and 36 emergency vehicles serving an area of 110 square miles. The department is staffed by 450 paid personnel.

Paging Alerting System

The Broward County Fire Department receives requests for service through its 9-1-1 system or through seven digit lines. Personnel in the Dispatch Center open the speakers in selected stations to alert emergency crews. Call information is then sent to computers, printers, and pagers in each fire station. All emergency response units carry pagers. Tones and bells are not used with this system.

Fire alerting systems for surveyed cities share many common features. All receive the majority of their request for service through 9-1-1. Station alerting generally consists of a system that turns on lights, generates alert tones over the PA, and opens the PA to receive a following voice message. There are a wide variety of systems to alert the stations. They range from custom designed alert systems, to CAD interfaced computer terminals. They used wire-line or radio as their communications media. Some provide paper printouts of call details and have a means of acknowledging the alarm through a button press. Backup systems vary widely. Some have radio or public leased telephones available when their primary system is out, while other utilize a tiered approach, allowing several levels of redundancy.

The research survey has identified the following advantages and disadvantages of Emergency Alerting Systems successfully operating in comparable jurisdictions.

Advantages:

- Direct CAD terminal connection to fire stations provides detailed and accurate alert information to responding crews.
- Printed alert information at the station house provides detailed and accurate information that may be carried with responding units for location verification.

- Mobile data terminals in vehicles receive full alert information without having to share printed information or obtain details through voice dispatch.
- Automated CAD dispatching initiated by a call taker provides faster response times.
- Selective alerting of specific station house "zones" such as a particular bunkroom, dayroom, or the entire station provides less disturbance to non-responding personnel.
- City owned and maintained wire-line or fiber networks to stations provide more reliable station alerting than using leased lines.
- Alert status feedback from stations and status from vehicles provides intelligent CAD dispatch recommendations.

Disadvantages:

- Providing primary alerting over leased telephone lines is not reliable and is not NFPA 1221 compliant.
- Secondary station alerting by dial-up telephone is slow and potentially unreliable.
- Inability to selectively alert specific stations results in potential alert confusion and is an annoyance to non-responding stations.

The research survey has identified Mobile Data Dispatching, utilizing printed alert information and mobile data terminals in vehicles, as the alerting system technology most appropriate for the Houston Fire Department. A Mobile Data Alerting System is the system most suitable for exploiting the advantages of call taker initiated dispatching. As stated in the background section, the department already has an excellent UHF radio system that provides wide area voice communications over six fire department licensed channels and supports vehicle status reporting. It also supports secondary selective station alerting. Plans are already in place to upgrade this UHF system with modern equipment providing easier maintenance. Information

gained from the survey research indicate that Mobile Data Terminals in vehicles provide complete information to fire and EMS personnel without the need to remember or write down alert information.

DISCUSSION

An efficient Emergency Alerting System has always been an important component of a successful fire department communications system. However, the modern fire service now expects the Emergency Alerting System to do more than just turn on lights and generate a voice message over the house PA. The modern fire department requires a CAD generated alerting system, connected to each station house, that allows a call taker to process an emergency call and send the response information directly to the required station house along with any apparatus that may be on the air. According to the Fire Department Communications Manual, a verbal dispatch to multiple units using conventional radio methods may take as much as one minute for broadcast and acknowledgement. The same dispatch can be done digitally over mobile data in less than five seconds (1995, p. 9). This statement concurred with the Houston Fire Department's average verbal dispatch speed of 39 seconds. In 1995, the Fire Department Communications Manual noted that increased demand for more and better communications, while still meeting the basic objective of rapid dispatch, has caused many departments to turn to digital data communications. According to NFPA Standard Number 1221, 1994 Edition, "The dispatch of the appropriate fire services shall be made within 60 seconds after completing receipt of an emergency alarm" (NFPA 1221, 1994, p.8). The implementation of a mobile data network is the only way to obtain an overall dispatch time of 60 seconds or less. The Fire Department

Communications Manual noted in (1995) that new mobile data technology would quickly bring new communication features to the fire service. Tied to a digital radio, computers can quickly provide important text or images to responding units. However, it should be noted that according to the Communications Systems Survey results included in this paper, only 17 percent of the surveyed departments utilized mobile data technology.

The obvious implication of this report is the FCC's trend to auction certain segments of the electromagnetic spectrum will continue and even accelerate. As demand rises for commercial bandwidth, spectrum becomes increasingly scarce, placing non-revenue generating public sector users, such as the Houston Fire Department, under increasing pressure to relinquish portions of their critical emergency bandwidth allocations. Protecting life and property from fire and other emergencies is the mission of the fire service and we cannot accomplish this mission unless we apply the most efficient and innovative technologies to the task. Therefore, the Houston Fire Department and the fire service in general should look at the challenges presented by the FCC's decision to reallocate public sector bandwidth as opportunities to implement cutting edge technologies. The need for replacing the Fire Department MAS provided the Houston Fire Department with an opportunity to review the most advanced alerting operations and to apply the information gathered to recommending an appropriate alerting system for the department.

RECOMMENDATIONS

The findings of this research paper supports an Emergency Alerting System solution based on Mobile Data Technology. The recommended Emergency Alerting System is a mobile data radio network, which will allow a dispatcher to alert a fire station and print pertinent dispatch information from the Computer Aided Dispatch System. The recommended system will also, allow a call taker to process an emergency call and send the response information directly to the required fire station along with any apparatus that may be on the air. Implementation of this plan will allow the Houston Fire Department to reduce its average verbal dispatch speed from 39 seconds to five seconds, thereby allowing the department to obtain an overall dispatch time of less than 60 seconds. Implementing a mobile data network that incorporates the best features of the Emergency Alerting Systems surveyed in this research project will provide the citizens of Houston with a cutting edge alerting systems that will save lives well into the 21st century.

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APPENDIX A

January 26, 1998

Name
Title
Address
City, State, Zip Code

Dear Fire Chief:

We are conducting a nationwide survey among Metropolitan Fire Chiefs and upper-level managers in fire and rescue services. The purpose of this survey is to gather viable information on Emergency Alerting Systems used in similar jurisdictions in order to develop an Emergency Alerting System Replacement Plan for the Houston Fire Department. We are also interested in information on various voice communications systems that are utilized by similar progressive departments. Your answers will allow the Houston Fire Department to choose the best method of providing emergency fire service communications for the citizens of Houston.

It will only take a short time to answer the simple questions in the enclosed questionnaire and to return it in the reply envelope or you may fax it to (713) 247-3303.

Of course, all answers are confidential and will be used only in combination with those of other Fire Chiefs and upper-level fire service managers.

If you are interested in obtaining a copy of the survey findings, just write your name and address at the end of this questionnaire and we will gladly send you a complimentary copy when it is completed.

Please return the completed questionnaire at your earliest convenience.

Thanking you in advance,

T. E. Patterson,
Assistant Fire Chief

TEP:ic

APPENDIX B

COMMUNICATION SYSTEMS SURVEY

1. Department/Agency Name _____

2. What is the population of the area served? _____

3. Number of fire stations? _____

4. What is size of area served in square miles? _____

5. How many emergency vehicles does your department utilize? _____

6. Number of personnel in your department? _____

7. Please check the category that best describes your department's communications center's method of dispatcher staffing.

   [1] Civilian
   [2] Uniformed Firefighter
   [3] Combination – Uniformed Firefighters and Civilians
   [4] Other _____

8. Type of service provided by your department's communications center: (Check all that apply).

   [1] Police Dispatching
   [2] Fire Dispatching
   [3] EMS Dispatching
   [4] EMS Pre-arrival Instructions
   [5] EMS Call-Taking
   [6] Fire Call-Taking
   [7] Police Call-Taking

9. How many Fire incidents per year does your communications center handle? _____

10. How many EMS incidents per year does your communications center handle? _____

11. How many Call-Taker positions does your communications center provide? _____

12. How many Fire and EMS dispatch consoles does your communications center provide? _____

13. Does your department provide EMS transports? Yes [1] No [2]

14. Are suppression vehicles utilized as EMS first responders? Yes [1] No [2]

15. How many voice radio channels does your department use?_____

16. Briefly describe your departments voice radio system: _____

_____

_____

_____

_____

17. Briefly describe your departments station alerting system:_____

_____

_____

_____

_____

18. Briefly describe your departments Computer Aided Dispatch (CAD) System:_____

_____

_____

_____

_____

19. Which of the following equipment is provided at your centers call-taking positions? (Check all that apply).

1	ANI/ALI
2	TDD
3	ANI/ALI CRT
4	ANI
5	ALI
6	CAD Terminal

20. Does your department utilize Mobile Automatic Status Terminals (MAST)?

Yes 1 No 2

21. If yes, to question #20, briefly describe your departments MAST System: _____

22. How has the Federal Communication Commission's mandate to reallocate MAS spectrum affected your department?

23. Does your department utilize Mobile Data Terminals? Yes [1] No [2]

24. If yes to question #23, briefly describe your department's MDT System: _____

25. What are the advantages of your departments voice radio system? _____

26. What are the disadvantages of your department's voice radio system? _____

27. What are the advantages of your department's station alerting system? _____

28. What are the disadvantages of your department's station alerting system? _____

29. If your department had an opportunity to implement a new voice radio system, which system would it choose and why?

30. If your department had an opportunity to implement a new station alerting system, which system would it choose and why?

* *

(For a copy of survey findings, please provide your name and address in the spaces below.)

Name _____

Address _____